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(54) A PROCESS AND APPARATUS FOR COATING PAPER AND CARDBOARD

(71) We, RHONE-POULENC INDUSTRIES, a body corporate organised and existing under the laws of France, of 22 avenue Montaigne, 75 Paris 8ème, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improvement to processes for coating papers and cardboards and more particularly to a continuous process for regulating and regularizing the thickness of the coating of an aqueous composition deposited in excess on a continuous strip of paper or cardboard supported by the lateral surface of a cylinder, whereby the excess coated substance is removed by scraping. It is also directed at an apparatus for carrying out the process and to coated papers and cardboards obtained by said process.

It is known that in principle, the aqueous compositions for coating paper and cardboard contain pigments and binders. The most frequently used pigment is mineral clay. In a small proportion compared with the mineral clay, it is also possible to use other pigments such as calcium carbonate, titanium oxide, hydrargillite, talc or barium sulphate. These pigments are dispersed in water, generally in an alkaline medium and in the presence of dispersing agents, the most important of which are tetrasodium pyrophosphate, sodium hexametaphosphate and low molecular weight polyacrylates in quantities between 0.2 and 0.5% by weight compared with the pigments. These pigments are fixed to the paper or cardboard by means of binders. Generally, the binders consist of an aqueous dispersion of a synthetic polymer such as a styrene/butadiene copolymer, an acrylic polymer or a vinyl acetate polymer, either used alone or mixed with natural binders such as starches, proteins or casein or synthetic binders such as polyvinyl alcohols. It is generally possible to mix the aqueous dispersions products which are able to improve the water retention properties of the coating compositions such as carboxymethyl celluloses or alginates. Finally, the coating compositions can contain various other ingredients, such as cross-linking agents, antifoaming agents, lubricants, optical brightening agents and colouring agents.

A paper or cardboard coating process is known in which on one of the faces of a paper or cardboard strip, a quantity in excess of the aqueous composition is continuously deposited generally by means of a coating roller. The excess material is then removed by scraping by means of a so-called smoothing blade. The coating speed is generally between 300 and 1500 m/min. The quantities of aqueous composition deposited on the paper or cardboard by the coating roller are generally between 200 and 800 g/m². Depending on the rigidity of the blade, the pressure which is applied thereto, the distance between the blade and the paper or cardboard, the compressibility of the paper or cardboard and the rheological properties of the coating bath the quantity of dry material deposited on the paper or cardboard after coating can vary between 6 and 15 g/m².

When coating according to this process, streaks can occur on the coating as a result of particles whose size is greater than the distance between the blade and the paper or cardboard, whereby said particles jam between the blade and the paper or cardboard. These particles may come from the coating bath or may comprise various aggregates such as blots present on the surface of the paper or cardboard. It is also possible to observe defects in the uniformity of spreading the coating on the surface of the paper or cardboard in the form of furrows and projections often due to irregularities in the paper or cardboard. They are made all the more readily visible due to the fact that during the coating operation turbulence occurs in the coating excess which the blade is required to remove by scraping.

The process forming the object of the present invention makes it possible in an unexpected manner to significantly reduce these disadvantages.

According to the present invention in one aspect there is provided a process for the continuous regulation and regularization of the thickness of an aqueous composition coating deposited in excess on a continuous strip of paper or cardboard supported by the lateral surface of a cylinder, in which the coating excess is removed by scraping and the scraping is performed by means of at least two successive scraping blades.

The final blade is called the smoothing blade and the other blade or blades are called premetering blades. In practice, the number of blades is at the most equal to four.

To prevent a reduction in the quantity of water by absorption through the paper or cardboard or by evaporation in the air when passing from the first to last blade, the distance between said two blades must be as small as possible. This reduction in the quantity of water could also lead to streaks caused by expansion in contact with the final blade. In practice, the distance between the free ends of the first and last blades applied against the coating of aqueous composition is generally between 0.2 and 50 centimetres.

In order to bring about a maximum improvement of spreading and reduce to the greatest possible extent the risks of streaks being formed, the distance between the first blade and the strip is regulated in such a way that the weight of the coating left on the strip by said blade, expressed in dry material, is between 10 and 50 g/m².

In order to permit a completely satisfactory performance of the invention, each of the blades is inclined relative to the strip by an angle of 5 to 60°.

The process according to the invention makes it possible to obtain coatings of regular thickness, which are free from streaks and furrows corresponding to quantities of dry material generally between 5 and 15 g/m² without decreasing the viscosity of the coating baths. It is found that through the use of 3 or 4 blades, a coating with a better appearance is generally obtained than when using only two blades.

A machine for coating paper or cardboard for realizing the process of the invention comprises at least one assembly having a supporting cylinder (or more commonly a supporting surface) on the outer surface of which is displaced a continuous strip of paper or cardboard and a wetting or coating roller which serves to transfer to said paper or cardboard strip a coating of an aqueous composition taken from a suitable reservoir.

According to the present invention in another aspect there is provided apparatus for regulating and regularizing the thickness of the coating of aqueous composition deposited in excess on a continuous paper or cardboard strip supported by the lateral surface of a cylinder of a paper or cardboard coating machine, comprising at least two successively arranged blades, of which one of the ends is free and applied to the aqueous composition coating, and means for regulating the angle of each of the blades relative to the strip and means for regulating the distance between each of the blades and the strip. The number of blades is generally at the most equal to four.

For a satisfactory performance of the invention, the distance between the free ends of the first and final blades applied against the aqueous composition coating is between 0.2 and 50 centimetres.

An embodiment of the invention will now be described, by way of an example, with reference to the accompanying drawings, in which:—

Figure 1 is a schematic elevation of a paper or cardboard coating machine provided with apparatus for carrying out the process according to the present invention,

Figure 2 is a side view of the apparatus according to the prsent invention mounted on the coating machine,

Figure 3 is a front view of the apparatus according to the present invention mounted on the coating machine, and

Figure 4 is a plan view of the apparatus according to the present invention mounted on the coating machine.

The apparatus according to the invention forms part of a conventional paper or cardboard coating machine, whereof the main components are shown schematically in Figure 1. This machine substantially comprises a supporting cylinder 1 which rotates in the direction of the arrow about axis 0. On the outer surface of the supporting cylinder 1 is wound a continuous strip of paper or cardboard 2 supplied from a reel (not shown). This strip 2 is caused to be applied to the supporting cylinder 1 over a given winding arc by an appropriate conventional device, for example one or several tension rollers 3.

A rotary coating roller 4 is partly submerged in a certain quantity of an aqueous composition 5 contained in a reservoir 6 and is also in tangential contact with the strip 2 in such a way that during its rotational movement, it transfers a coating 4a of aqueous composition, carried along by its lateral surface to the surface of strip 2. Figure 1 shows an appropriate relative position of coating roller 4 below the supporting cylinder 1, but it is obvious that any random appropriate relative position can be adopted. Moreover, a random number of coating rollers can be associated with the supporting cylinder 1, whereby each of them is able to transfer a given quantity of aqueous composition to the strip 2.

The aqueous composition 5 can be a random known composition suitable for giving a suitable coating to the strip 2 and normally con-

tains one or more pigments such as for example kaolin, calcium carbonate, titanium oxide, hydrargillite, talc, barium sulphate and one or more binders, such as for example synthetic polymers, starches, proteins or casein. The solids content of the composition is between 50 and 65% by weight.

The regulating apparatus 7 according to the invention is located on the periphery of strip 2 downstream of the coating roller 4. It has a vertical plane of symmetry perpendicular to rotation axis 0 of the supporting cylinder 1.

The regulating apparatus 7 essentially comprises two scraping blades 8 and 9, and one of the ends of each blade is applied against the strip 2, respectively at points P and Q. Blades 8 and 9 are respectively fixed by their other end to blade holders 10 and 11 by means of screws such as 12. Blade holders 10 and 11 are respectively articulated with respect to supports 13 and 14 in such a way that each of their two ends, provided with a guidance member 15 can move in a direction orthogonal to axis 0 within a slot 16 formed in the corresponding support 13, 14. Knurled buttons 17 and 18 mounted respectively on supports 13 and 14 permit, by means of conventional mechanical means (not shown), the sliding and maintaining in position of guidance members 15 in windows 19 made in the slots 16 and thus regulate the distance between each of the blades 8 and 9 on the one hand and the strip 2 on the other.

Each support 13, 14 is provided with two trunnions 20 engaged in recesses 21 made in side plates 22, permitting the pivoting of the supports about an axis parallel to axis 0. In this way, it is possible to regulate to the desired value the inclination angle of each of the blades 8 and 9 relative to the strip 2. The side plates 22 are interconnected by bars 23 and 24 maintained in position by nuts 25 and 26.

The side plates 22 are able to pivot about a shaft 27 parallel with the axis 0 and carried by members 28 integral with the frame 29 of the coating machine. Side plates 22 are fixed in position by assembling with members 28 by means of screws 30. Stops 31 carried by the side plates 22 prevent the blades 8 and 9 from striking the supporting cylinder 1 during the assembly of the apparatus according to the invention on the coating machine. For reasons of clarity, bars 23 and 24, nuts 25 and 26, members 28 and frame 29 are not shown in Figure 4.

Locking pins 32 and 33, located in recesses such as 34 provided in the supports 13 and 14 make it possible to maintain said supports and consequently blades 8 and 9 in the selected inclined position corresponding to an angle of 30, 35, 40 or 45 degrees relative to the strip 2. For this purpose, the locking pins 32 and 33 are respectively engaged and maintained in the engagement position in recesses 35 and 36 made in side plates 22 by means of knurled buttons 37 and 38 which are able to slide in openings 39 and 40 provided in recesses such as 34.

Hereinafter, several examples for performing the process of the invention are given.

Examples 1 to 5

An aqueous coating composition is prepared which contains the constituents and their respective contents by weight shown hereinafter:

Kaolin	100
Sodium hexametaphosphate	0.4
Carboxylated butadiene/styrene	14
Carboxymethyl cellulose	0.4

The coating composition is brought to a pH of 8.5 by adding ammonia and is adjusted in such a way that it contains 60% by weight of dry substance.

A quantity in excess of the coating composition is deposited continuously on one of the faces of a strip of paper of 74 g/m² by means of a coating roller then, by scraping by means of one or several blades whose inclination angle relative to the strip is regulated to 30 degrees, the coating excess is removed in such a way that a coating layer of 9 g/m², expressed in weight of dry substance, is obtained.

The thus coated paper is dried in a tunnel furnace at a temperature of 100°C, then undergoes calendering consisting of being passed four times in succession between two cylinders under a load of 80 kg/cm.

In Example 1, which is given for comparison purposes, a single scraping blade is used.

In Examples 2, 3, 4 and 5 according to the invention, an apparatus is used which has a premetering blade and a smoothing blade. The distance between the free ends of the premetering blade and the smoothing blade is regulated to 2 cm and the position of the premetering blade is regulated in such a way that the weight of the coating left by said blade, expressed in dry material is respectively 12, 20, 25 and 48 g/m².

The spreading quality is evaluated by means of the so-called "Microcontour test", whose principle is as follows:—

An ink formed from a course grained pigment is dispersed in an oil of average viscosity and marketed by Etablissements Lorilleux Lefranc under the name "ink for microcontour test" and is deposited in excess on the paper. As the pigment particle dimensions are greater than the diameter of the paper pores, the pigment cannot penetrate into the paper. After appropriate wiping, the quantity of pigment left on the paper increases in proportion to the roughness of the paper. The colouring intensity obtained thus makes it possible to evaluate roughness and also the size of the furrows.

Table 1 gives the results obtained in each of the Examples.

TABLE 1

	Example 1.	Example 2.	Example 3.	Example 4.	Example 5.
Colouring intensity	Relatively high.	Small	Small	Small	Relatively small.

It can be seen that the use of premetering blade leads to coated papers with a reduced roughness.

Examples 6 to 9

Working takes place under the same conditions as in Examples 2 to 5, but using an apparatus having two premetering blades and one smoothing blade. The distance between the free ends of the two premetering blades is regulated to 2 cm and the distance between the free ends of the second premetering blade and the smoothing blade is also regulated to 2 cm. The position of the premetering blade is regulated in such a way that the weight of the coating left behind by said blades, expressed in dry material is as indicated in Table 2.

TABLE 2

	Example 6.	Example 7.	Example 8.	Example 9
Coating weight left by first premetering blade (g/m^2)	20	30	45	65
Coating weight left by second premetering blade (g/m^2)	12	20	25	48

The microcontour test shows that the colouring intensity and consequently the roughness of the coated papers obtained are smaller than those of the coated papers obtained in Examples 2 to 4.

WHAT WE CLAIM IS:—

1. Process for the continuous regulation and regularization of the thickness of an aqueous composition coating deposited in excess on a continuous strip of paper or cardboard supported by the lateral surface of a cylinder, in which the coating excess is removed by scraping and the scraping is performed by means of at least two successive scraping blades.

2. The process claimed in claim 1, in which the number of blades is at the most equal to four.

3. The process claimed in claim 1 or claim 2, in which the distance between the free ends of the first and last blades applied against the aqueous composition coating is between 0.2 and 50 centimetres.

4. The process claimed in any one of claims 1 to 3, in which the distance between the first blade and the strip is calculated in such a way that the weight of the coating left on the strip by said blade, expressed in dry material, is between 10 and 50 g/m^2.

5. The process claimed in any one of claims 1 to 4, in which each of the blades is inclined relative to the strip at an angle between 5 and 60 degrees.

6. A process for the continuous regulation and regularization of the thickness of an aqueous composition coating deposited in excess on a continuous strip of paper or cardboard supported by a cylinder, substantially as hereinbefore described with reference to the accompanying drawings.

7. Apparatus for regulating and regularizing the thickness of an aqueous composition coating deposited in excess on a continuous strip of paper or cardboard supported by the lateral surface of a cylinder of a paper or cardboard coating machine, comprising at least two successively arranged blades, of which one of the ends is free and applied to the aqueous composition coating, and means for regulating the angle of each of the blades relative to the strip and means for regulating the distance between each of the blades and the strip.

8. Apparatus as claimed in claim 7, in which the number of blades is at the most equal to four.

9. Apparatus as claimed in claim 7 or claim 8, in which the distance between the free ends of the first and last blades to be applied against the aqueous composition coating is between 0.2 and 50 centimetres.

10. Apparatus as claimed in any one of claims 7 to 9, in which each blade is fixed by its other end to a blade holder articulated with a support in such a way that each of the two ends of the blade holder, provided with a guidance member, can move in a direction orthogonal to the axis of the cylinder within a slot provided in said support.

11. Apparatus as claimed in claim 10, including means for bringing about the sliding and maintaining the position of the guidance member in a window made in the corresponding slot.

12. Apparatus as claimed in claim 10 or claim 11, in which each support is provided with two trunnions engaged in recesses provided in side plates permitting it to pivot

about an axis parallel to the rotation axis of the cylinder.

13. Apparatus as claimed in claim 12, in which the side plates can pivot about a shaft parallel to the rotation axis of the cylinder and carried by members integral with the frame of the coating machine.

14. Apparatus as claimed in claim 13, in which the side plates are fixed in position by assembly with said members.

15. Apparatus as claimed in any one of claims 12 to 14, in which the supports are maintained in the chosen inclined position by means of locking pins located in recesses provided in said support and which can be engaged and maintained in an engagement position in recesses provided in the side plates.

16. Apparatus for regulating and regularizing the thickness of an aqueous composition coating deposited in excess on a strip of paper or cardboard supported by a cylinder of a coating machine, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

17. Coated cardboards and papers, obtained by the process claimed in any one of claims 1 to 6.

18. Papers and cardboards having a coating of an aqueous composition as claimed in claim 17, in which the coating has a regular thickness, is free from furrows and streaks and corresponds to a quantity of dry material between 5 and 15 g/m^2.

19. Papers and cardboards having a coating of an aqueous composition, in which the coating has a regular thickness, is free from streaks and furrows and corresponds to a quantity of dry material between 5 and 15 g/m^2 and is obtained by the process according to any one of claims 1 to 6.

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Sheet 1

Fig.1

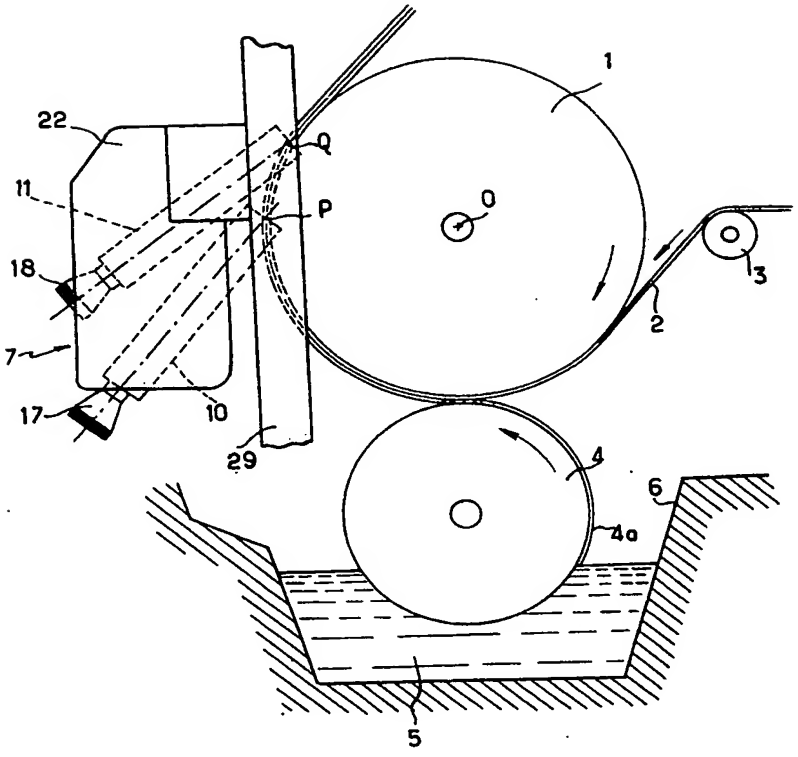
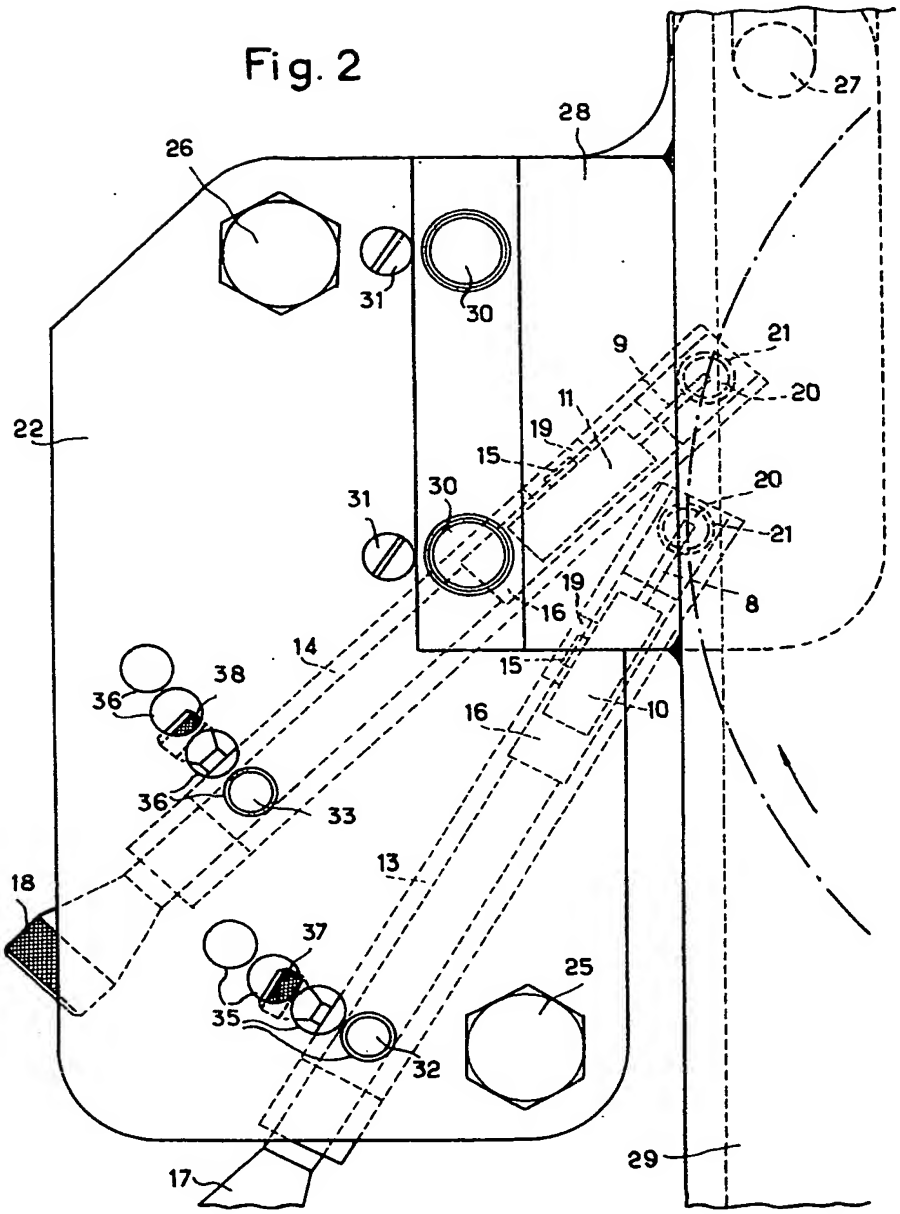


Fig. 2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Sheet 3

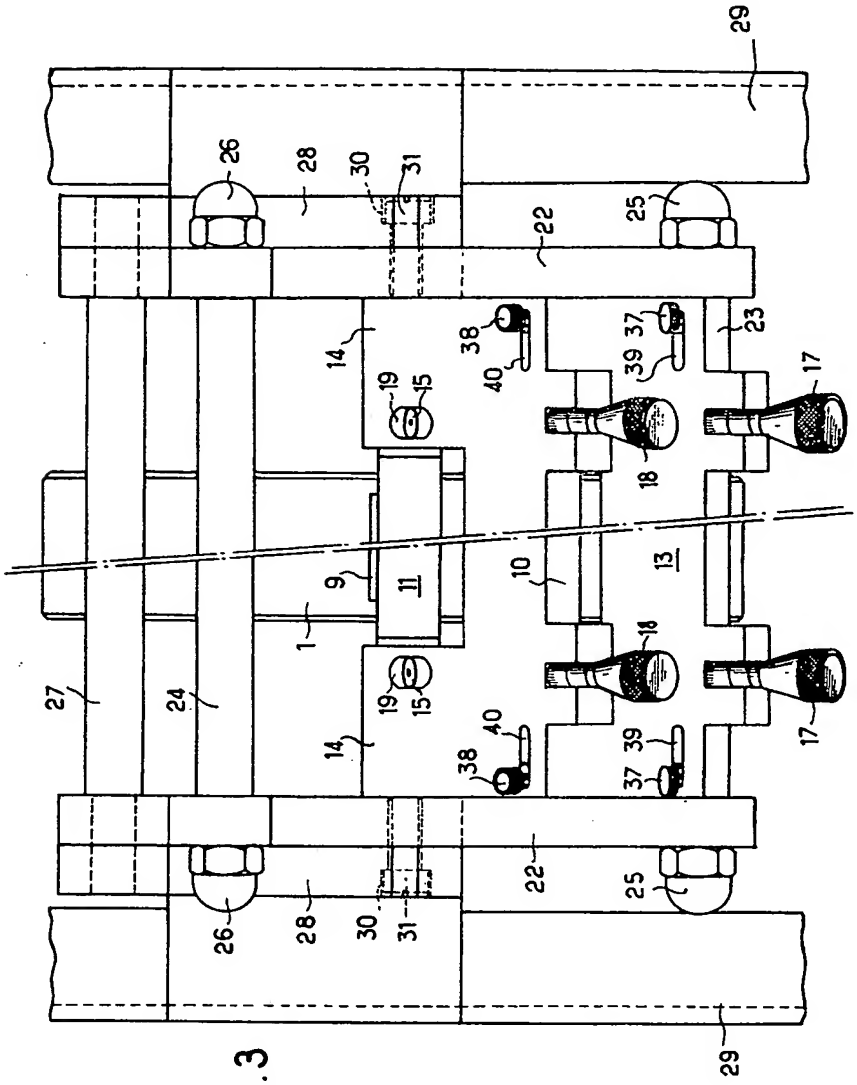

Fig.3

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Sheet 4

Fig. 4